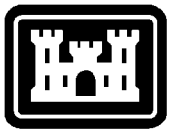

US Army Corps
of Engineers®

EM 200-1-3
1 February 2001

ENVIRONMENTAL QUALITY

Requirements for the Preparation of Sampling and Analysis Plans

ENGINEER MANUAL

AVAILABILITY

Electronic copies of this and other U.S. Army Corps of Engineers (USACE) publications are available on the Internet at http://www.usace.army.mil/inet/usace-docs/. This site is the only repository for all official USACE engineer regulations, circulars, manuals, and other documents originating from HQUSACE. Publications are provided in portable document format (PDF).

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

EM 200-1-3

CEMP-RA

Manual
No. 200-1-3

1 February 2001

Engineering and Design
REQUIREMENTS FOR THE PREPARATION OF SAMPLING AND ANALYSIS PLAN

1. Purpose. This manual provides guidance for the preparation of project-specific sampling and analysis plans (SAP) for the collection of environmental data. In addition, default sampling and analytical protocols are included which may be used verbatim or modified based upon project-specific data quality objectives (DQOs). The goal of this manual is to promote consistency in the generation and execution of sampling and analysis plans and thus to help generate chemical data of known quality for its intended purpose.

2. Applicability. This manual applies to all USACE Commands having responsibility for sampling and analysis of environmental samples. This includes, but is not limited to, USACE activities pursuant to and in support of execution of the following programs or sponsors: Defense Environmental Restoration Programs; Base Realignment and Closure; Superfund; Civil Works, Military Construction, installation environmental compliance; Defense Logistics Agency; Department of Energy; work for others; and any construction projects involving hazardous, toxic, and radioactive waste (HTRW).

3. Distribution Statement. This manual is approved for public release; distribution is unlimited.

FOR THE COMMANDER:

IO Appendices
(See Table of Contents)

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This manual supersedes EM 200-1-3, dated 1 September 1994.

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
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Manual
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Engineering and Design
REQUIREMENTS FOR THE PREPARATION OF SAMPLING AND ANALYSIS PLANS

Table of Contents

Chapter 1
Introduction

1.1 Purpose

This manual provides guidance for the preparation of project-specific sampling and analysis plans (SAP) for the collection of environmental data. In addition, default sampling and analytical protocols are included which may be used verbatim or modified based upon project-specific data quality objectives (DQOs). The goal of this manual is to promote consistency in the generation and execution of sampling and analysis plans and thus to help generate chemical data of known quality for its intended purpose.

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1.3 References

Required and related publications are listed in Appendix A.

1.4 Explanation of Acronyms and Terms

Acronyms and special terms used in this manual are explained in the glossary.

1.5 Functional Equivalencies

1.5.1 The SAP has replaced the document that was formerly known as the Chemical Data Acquisition Plan. SAPs prepared in accordance with the guidance provided by this manual are intended to be functionally equivalent to U.S. Environmental Protection Agency (USEPA) sampling and analysis plans, field sampling plans, and quality assurance project plans prepared under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and to data collection quality assurance plans and data management plans prepared under the Resource Conservation and Recovery Act (RCRA).

1.5.2 The SAP is divided into two parts: a field sampling plan (FSP) and a quality assurance project plan (QAPP). The FSP addresses the field activities, including all aspects of sampling, drilling, monitoring well installation, and any field data gathering activities. The QAPP addresses the data quality objectives, analytical methodologies, specific quality assurance (QA) and quality control (QC) activities, laboratory requirements, and data assessment activities designed to achieve the data quality goals of the project.

1.5.3 This manual contains requirements for format and contents of the SAP and instructions for specifying and executing sampling, analysis, and related tasks for measurement of chemicals in the environment. Certain situations may require that the SAP be written differently from the format described in this manual. For example, work performed on behalf of certain USEPA regions may follow

a different SAP format from that prescribed within this manual. Many states have their own regulations regarding underground storage tanks, which may also impact SAP preparation. This manual complements existing USACE guidance as referenced in Appendix A.

1.6 Discussion

1.6.1 The SAP is a document prepared by an architect-engineer (A-E) firm, a remedial action contractor, or USACE to describe the project requirements for all field and laboratory activities, any data assessment activities, and contract deliverables related to the reporting of chemical data for HTRW remedial activities. When the SAP is prepared under contract (e.g., with an A-E firm), it is done in response to a scope of work (SOW) prepared by USACE that describes specific tasks and objectives of the project. Investigative projects include preliminary assessment/site inspections (PA/SI), remedial investigation/feasibility studies (RI/FS), engineering evaluation/cost analyses, RCRA facility assessments, RCRA facility investigations, and corrective measure studies.

1.6.2 In addition to investigative projects, this manual may be used for developing plans for data collection activities such as predesign bench and/or pilot studies, remedial action or post-closure monitoring, perimeter or offsite ambient air monitoring, etc. The size and complexity of a project will be reflected in the SAP. Although the guidance in this manual is applicable to radioactive wastes, unexploded ordnance, chemical warfare agents, and biological wastes, additional guidance may be necessary to prepare SAPs involving these materials. When chemical data are acquired, the SAP is one component of the overall project work plan. SAPs are required for each contractor work order. All details of field and laboratory activities must be described in the FSP and QAPP, respectively. These documents must be submitted to the appropriate USACE technical staff for review, comment, and approval. Once approved, the SAP represents the standard to which all activities are compared to assure compliance.

1.7 Relationship of SAP to the Project Work Plan

Per other USACE guidance on scoping HTRW investigative projects involving generation of analytical data, the SAP is included as an attachment to the project work plan. For those projects in which a work plan is not required, such as certain remedial actions, the SAP must be a stand-alone document.

1.7.1 Project work plan. The project work plan is an umbrella document that addresses, but is not necessarily limited to, the following subjects.

1.7.1.1 Project background. This section includes a brief summary of the site: size and location; ownership history; authority under which the work is to be performed; and the purpose and scope of the work plan. The inclusion of maps noting the location of the project within a state or county is recommended.

1.7.1.2 Site description and history. This section includes a description of the geology of the site, building structures, if any, topography of the site, etc. Other relevant information may include annual precipitation, prevailing wind direction, and site hydrology. It also includes a brief history of the site in terms of former activities, reported spills, and waste disposal practices that may have contributed to potential contamination over the years.

1.7.1.3 Previous investigations. This section includes discussion of previous investigation activities and other response activities at the site and also any problems and/or data anomalies.

1.7.1.4 Project objectives (long- and short-term). This section explains the purpose of the project: the regulatory framework under which the work is being conducted, what goals are to be met; and what questions are to be answered. In the case of a PA/SI, the objectives might include a determination of whether there is enough evidence to support the need for an RI/FS. In the case of an RI/FS, the objectives might include site contamination characterization in terms of extent and concentration, risk assessment, and the screening of remedial action alternatives. Applicable or relevant and appropriate requirements should be addressed. Much of the information in this chapter is helpful in guiding the preparation of the SAP.

1.7.1.5 Data gaps. This paragraph provides information regarding data gaps that need to be filled in order to make project decisions, such as defining the extent of contamination and choosing remedial action alternatives.

1.7.1.6 Data quality objectives (DQOs). This paragraph describes how data will be used to make project decisions. This paragraph may serve as a general scoping guide for data acquisition activities defined in the SAP.

1.7.2 SAP. The attachments to the project work plan (SAP, site safety and health plan, etc.) provide details of the specific data collection activities that are designed to support the objectives of the project, as set forth in the work plan. Information in the project work plan and SAP should not be redundant. Project-specific DQOs, including measurement quality objectives (MQOs) for precision, bias, representativeness, completeness, comparability, and sensitivity are addressed in the SAP. MQOs are applicable to both sampling and analytical portions of the project.

1.8 Technical Project Planning

1.8.1 As prescribed within Engineer Manual (EM) 200-1-2, Technical Project Planning Process, USACE and/or contractor technical planning teams are responsible for developing project-specific data collection programs that define the quality and quantity of data needed to perform all the engineering and scientific evaluations required for the project.

1.8.2 Initially, USACE and/or the contractor must identify the appropriate data users needed for the project. Data users involved are project dependent, and may include the customer, regulators, risk assessor, compliance or regulatory specialist, remedial design engineers, an attorney, etc. Data users will determine initial data needs in order to perform specific evaluations and make the engineering and scientific judgments required to complete the necessary activities leading to site closeout.

1.8.3 Sampling and analysis data implementors provide input to planning specific data collection tasks and are responsible for task execution based upon the project data needs. Data implementors are also chosen based upon the project and include technical personnel such as a geologist, hydrogeologist, chemist, statistician, sampling personnel, etc. This manual provides guidance to these data implementors for preparing SAPs for conducting field and analytical work and is a source of standard operating procedures (SOPs).

1.8.4 This manual provides both data users and implementors with a vehicle to prescribe sampling and analytical protocols necessary to achieve data quality objectives dictated by the technical project planning process.

1.9 Overview of Manual

1.9.1 This manual consists of four chapters, ten appendices and a glossary. Chapter 2 presents guidelines for use of the manual. Chapter 3 discusses format and content requirements of FSP and QAPP components of SAP. Chapter 4 lists guidelines for developing sampling and analysis protocols when those protocols in Appendices C, D, E, F, G, H, and I are not appropriate. Appendix B presents a table of holding times, preservatives, and sample containers for various parameters. Appendix C presents instructions for collecting environmental samples from various media. Appendix D gives hazardous waste sampling instructions. Appendix E gives sample handling instructions. Appendix F presents sample documentation and shipping instructions. Appendix G describes field QA/QC elements and procedures. Appendix H presents guidance on the application of field analytical technologies. Appendix I discusses general and method-specific chemical analysis requirements. Appendix J provides a review checklist for SAPs.

1.9.2 This manual will be revised as needed by modifying/adding instructions to incorporate changes and innovations within the environmental community, as well as changes in USACE policy.

Chapter 2
Utilization of this Engineer Manual

2.1 General

This chapter discusses how this manual may be used to prepare, review, and implement an SAP. It also describes how the manual may be used by USACE personnel as a source for specifying sampling instructions when preparing the SOW or, in the case of a site-remediation project, the plans and specifications for the project. How to execute an SAP and verify compliance with the field and analytical procedures specified in the SAP are briefly described also.

2.2 Scope of Work Preparation

2.2.1 This engineer manual contains information that may be used during the technical planning of projects and generation of project SAPs. It is a USACE mission to characterize and remediate HTRW-contaminated sites in an efficient, cost-effective, and technically sound manner. To attain this goal, technical planning teams should utilize other USACE guidance for standard outlines on scoping HTRW investigations, chemical quality assurance, and HTRW technical project planning. Refer to EM 200-1-6, Chemical Quality Assurance for HTRW Projects; and EM 200-1-2, Technical Project Planning (TPP) Process, for information on scoping, the QA elements available for Chemical Data Quality Management (CDQM) execution, and technical project planning protocols, respectively. With the assistance of these guidance documents, the technical team must at a minimum generate a project SOW that clearly identifies project goals, associated data needs, and application of QA elements based upon the project goals designed to reach site closeout. The team may decide to further clarify the effort within the SOW by identifying specific requirements for implementation of defined data collection options or a specific data collection program, or appropriate performance and/or measurement quality objectives for QC samples and corrective actions necessary.

2.2.2 The appendices of this manual contain sampling and analytical SOPs that may be considered when identifying the data collection options and/or program. These include, but are not limited to, various matrices sampling and sample handling techniques, analytical methods, field and laboratory QA/QC protocols, documentation requirements, and appropriate references. DQO statements that describe the data collection design for sampling and analysis of each matrix must be defined.

2.2.3 USACE personnel may specify in the SOW or plans and specifications the individual instructions or SOPs that should be used in the SAP, or they may simply reference this manual as a source of SOPs. Contractors providing services for USACE may have their own sampling and analytical SOPs that would be suitable for a given project. In these cases, this manual provides a format for structuring the contractor's instructions for inclusion in the SAP. This will ensure continuity in the HTRW program. If project-specific objectives and strategies cannot be satisfied by any of the instructions in the relevant appendices, references for alternate sampling and analytical methods are included in Appendix A. Paragraph 4.4 of this manual discusses how to develop new sampling and analysis instructions.

2.3 SAP Preparation

The following three-step approach is suggested to prepare the SAP. The SOW or plans and specifications will specify the extent to which the architect/engineer or remedial action contractor will interact with USACE during the three-step approach.

2.3.1 Step 1: Consult with technical planners. Contractors working under agreement with USACE should initially consult with USACE technical planners to obtain project information. This step is not applicable to USACE in-house projects because USACE technical planners (technical managers and/or project scientists/engineers) actually prepare the SAP. USACE technical planners may interact directly with their customer to obtain information. However, contractors working under an agreement with USACE should consult with USACE technical planners to obtain important facility information, data from previous investigations, and information regarding site constraints.

2.3.2 Step 2: Review appropriate project documentation/literature. Before writing the SAP, perform a thorough review of all appropriate project documents. Foremost is the SOW or plans and specifications for the current work effort. These documents contain results from the technical project planning process as outlined in EM 200-1-2. As noted previously, the level of specificity outlined within these SOWs may vary from outlining general project goals with appropriate references to specifying sampling and analytical requirements to meet the project-defined data quality objectives for each matrix. Other applicable references required for background information should be identified within the SOW also. These may include, but are not limited to, applicable engineer regulations and guidance documents, regulatory program and status reports from previous studies and investigations, construction data, ownership/operational histories, site maps and photographs, information on regional and site geology, hydrogeology, hydrology, topography, ecology, climatology, demographics, and current and future land use.

2.3.3 Step 3: Review requirements for format and contents of SAPs. Chapter 3 discusses the general format and content requirements for the FSP and QAPP portions of the SAP. A good working knowledge of these requirements is necessary to understand the type of information required to draft an SAP and determine if additional sources of information are required. If it is determined that the sampling and/or analytical methods in the appendices of this manual or other existing references are not appropriate, Chapter 4 of this manual can be used to develop site-specific protocols.

2.4 SAP Review/Approval/Distribution

2.4.1 Review. The SAP should be reviewed to determine whether it will provide data that satisfy customer and technical planner data needs, whether it satisfies the data use and data quality objectives, and whether it is compatible with all site constraints. Reviewers should use the “review checklist” found in Appendix J as a guide for reviewing the SAP. This checklist is a very general guide and contains information that typically should be included in an SAP. USEPA/state guidance documents for preparing CERCLA/RCRA investigative plans may also be consulted.

2.4.2 Approval. After the SAP has been reviewed, the document can be accepted as is or returned to its authors for review comment resolution. Once the SAP has been approved, appropriate personnel sign the signature page, and the SAP becomes a contractual document. The USACE personnel that will sign the SAP will be determined on a project-specific basis by the technical planning team. It is recommended that the USACE technical manager sign the title page of the SAP and that the USACE chemist sign the title page of the QAPP. Any deviations from the approved document must receive

written approval from USACE. In addition, there may be significant changes in the project that necessitate that the SAP be appended or modified. Similar procedures of review and approval for those modified sections would be necessary prior to execution of the modifications.

2.4.3 Distribution. Once approved, the final SAP or its modifications must be distributed to all parties as defined within the SOW contract. These may include USACE technical manager, primary or referee (QA) laboratory(ies), any regulatory authorities, customer, and any subcontractors (i.e., drilling or sampling firms, data validation firms, etc.).

2.5 SAP Execution and Compliance

This manual may be used by USACE contractors and USACE oversight personnel as a guide for either executing the SAP or monitoring compliance with the SAP. Before data collection activities are implemented with either contractor or USACE resources, an approved SAP must be in place. All laboratories must have an approved SAP in order to be aware of project analytical requirements, must be able to meet and perform all aspects of the required chemical analyses, and must provide data reportables as specified within the QAPP portion of the SAP. Execution of the SAP must be performed in compliance with the approved SAP. Field personnel must be adequately trained for their duties and possess a full understanding of all aspects of the SAP. Sampling personnel shall ensure that proper field equipment is available and in good condition, and sample collection and handling procedures, including sample preservation, are performed in accordance with the prescribed sampling instructions or SOPs. A liaison between the field and laboratory (however named) shall be identified and shall ensure smooth transition of all samples from the field to the laboratory. Liaison duties may include implementation of proper sample packaging and shipping procedures and any communication or notification with the laboratory. Safety and health requirements and practices as defined in ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OEW) Activities, must be adhered to throughout all phases of environmental sampling operations. During the execution of the SAP, compliance is monitored by USACE by conducting field, desk, and laboratory audits. In addition, implementation of the project-defined QA elements (i.e., field control samples, referee laboratory analyses, data assessment procedures, etc.) allows additional insight into sampling and analysis activities. While data collection activities are being performed, the sampling team should communicate daily with appropriate USACE personnel regarding project status by submitting appropriate documentation as outlined in the SOW. Lastly, the final report review provides an opportunity for verification of DQO attainment, data assessment, and identification of any value-added procedures or corrective actions necessary. EM 200-1-6, Chemical Quality Assurance for HTRW Projects, provides guidance on field and laboratory techniques for assessing chemical data, identification of any limitations on data use, and recommended documentation procedures. The use of statistics during the data assessment may also be recommended by the regulatory authority.

2.5.1 Quality assurance (QA) elements. As defined in EM 200-1-6, there are several QA elements that may be applied to an HTRW project to ensure proper execution of CDQM. These include, but are not limited to, validation of chemistry laboratories, proper technical review/approval of project documents (i.e., SAP), field and laboratory audits, QA sample handling verification, referee lab (QA) sample analysis, use of single- and double-blind performance evaluation (PE) samples, data review and/or data validation, magnetic tape audits, and generation of Chemical Quality Assurance Reports and Chemical Data Quality Assessment Reports. The project SOW or, in the case of a site remediation project, the plans and specifications must define the appropriate QA elements to be applied to the project, the frequency of application, and any notification, contingency, or corrective action protocols necessary

in the event of deficiency or failure. This information must then be reiterated within the project documents to clearly define QA implementation procedures.

2.5.2 Audits. USACE personnel should conduct field and desk audits for all field sampling activities conducted as part of the HTRW program. Laboratory audits may be performed in conjunction with the laboratory validation process; district personnel are also encouraged to perform precontract or preaward system audits of the laboratory to ensure proper communication and awareness of project DQOs are in place. Combining these audits to increase overall effectiveness of the audit is recommended. The audits of field activities should be performed whether the project is executed in-house or by contractors for any phase of work from initial investigation to postclosure monitoring. This oversight is necessary to ensure that approved procedures, as specified in the SAP, are used to perform the work. Field audits include monitoring critical activities, such as well installation and well development, placement of other types of sample access devices (e.g., passive soil gas collection media), decontamination of equipment used to generate samples or other activities that could cause cross-contamination, sample collection from all media (i.e., air, ground water, surface water, soil, sediment, and waste), and postsample collection activities (packaging/shipping). Field audits should be scheduled as early in the activity as possible to identify procedures that could cause problems with the sampling and analytical results. Checklists included within EM 200-1-6 may be used to enhance consistency and completeness of the field audits conducted; as well as providing an aid for documenting the audit results. Another mechanism for monitoring field activities as they occur is to perform desk audits. This is usually done by reviewing daily contractor QC reports, chain of custodies, and field logs while the field activities are in progress. The SOW or plans and specifications should have a requirement stating that these reports be supplied on a periodic basis (e.g., daily or weekly).

2.5.3 Corrective action. The SAP should also address notification and corrective actions that should be followed by field and laboratory personnel if there are deviations from the SAP or problems with samples upon receipt at the laboratory. Typical problems/deviations include, but are not limited to, the following: improperly preserved samples, improper chain-of-custody documentation, broken sample containers, sample relocation, insufficient volume, etc. As a minimum requirement, the SAP should state that significant changes to or deviations from the approved SAP should not be made without the written approval of USACE. The QAPP should also describe corrective action procedures that are required if field and/or analytical procedures are found to deviate from the requirements in the SAP. Example corrective action measures include, but are not limited to, resampling with additional analysis of new samples, reanalysis of existing field or QC samples, or proper data qualification. Appendix I provides additional guidance on corrective action requirements of the laboratory.

Chapter 3
Sampling and Analysis Plan - Format and Contents

3.1 General

This chapter contains general guidance for the format and contents of an SAP, including a brief discussion of each of the major elements. Several additions have been incorporated in order to accommodate the technical requirements identified within the USEPA guidance EPA QA/R-5 and EPA QA/G-5. However, due to the disparity in the adoption or enforcement of this guidance among the various USEPA regions and State regulating agencies, the existing two-component format has been retained. The use and application of this or other project plan formats are at the discretion of the USACE technical team members. However, the technical contents of the plans should be equivalent.

3.2 Format Requirements

3.2.1 The SAP consists of two parts: an FSP and a QAPP. The FSP provides guidance for all fieldwork by defining in detail the sampling and field data-gathering methods to be used on the project. The QAPP describes the chemical data quality objectives, analytical methods and measurements, QA/QC protocols necessary to achieve the DQOs, and data assessment procedures for the evaluation and the identification of any data limitations. The FSP and QAPP should be submitted as a single document (although they may be bound separately to facilitate the use of the FSP in the field).

3.2.2 The FSP and QAPP are prepared prior to any field activities, but the FSP and QAPP may be amended or revised several times during the investigation activities using the protocol outlined in section 2.4 of this manual. Alternatively, the WP and associated SAP may develop a contingency-based, more flexible strategy to data gathering activities. This dynamic approach must outline a decision logic, which when supported by field analysis results promote decisions being made in the field about the subsequent site activities and/or refinement of the conceptual site model (CSM). Issues to be addressed within the SAP include establishing key field personnel experience requirements, the level of decision-making empowered to key field personnel, and communication protocols between the field and project stakeholders. For projects that encompass several subsites or involve a long-term contract (i.e., Total Environmental Restoration Contract), it may be beneficial to generate a comprehensive SAP that covers all aspects of sampling and analytical requirements conducted at a project and/or site. Then this document can be amended for individual delivery orders by generating an abbreviated, project-specific SAP. This addendum to the SAP must clearly identify the current effort's DQO, applicable matrices, site-specific sampling and analysis requirements, and any deviations from the comprehensive SAP. Information previously addressed within the comprehensive SAP may be referenced in the project-specific SAP addendums. When this approach is utilized, all SAP addendum topics referencing the comprehensive SAP must be verified by the USACE technical planning team during the document review process. Inadequate coverage of topics must be resolved prior to the SAP addendum execution. Preparatory phase inspections (field audits) must ensure that all appropriate plans (comprehensive and addendum SAPs) are available onsite and field personnel are familiar with procedures included within both.

3.2.3 Table 3-1 lists the typical elements that should appear in the FSP and QAPP. Depending upon the size and/or complexity of the project, all of the elements identified in Table 3-1 may not be appropriate for every project. In these instances, the format may be abbreviated or modified to accommodate the individual project activities.

Table 3-1
SAP Format Requirements

Title Page
Distribution List
Table of Contents

I Field Sampling Plan (FSP)

Title Page
Table of Contents

1.0 Project Background
- 1.1 Site History and Contaminants
- 1.2 Summary of Existing Site Data
- 1.3 Site-Specific Definition of Problems

2.0 Project Organization and Responsibilities
3.0 Project Scope and Objectives
- 3.1 Task Description
- 3.2 Applicable Regulations/Standards
- 3.3 Project Schedule

4.0 Nonmeasurement Data Acquisition
5.0 Field Activities by Area of Concern (AOC)
- 5.1 Geophysics
  - 5.1.1 Rationale/Design
    - 5.1.1.1 Method
    - 5.1.1.2 Study Area Definition and Measurement Spacing
  - 5.1.2 Field Procedures
    - 5.1.2.1 Equipment
    - 5.1.2.2 Preliminary Method Testing and Early Termination Procedures
    - 5.1.2.3 Instrument Calibration and QC Procedures
    - 5.1.2.4 Field Progress/Interpretation Reporting
    - 5.1.2.5 Measurement Point/Grid Surveying
    - 5.1.2.6 Data Processing
    - 5.1.2.7 Potential Interpretation Techniques
- 5.2 Soil Gas Survey
  - 5.2.1 Rationale/Design
    - 5.2.1.1 Soil Gas Sample Locations
    - 5.2.1.2 Sample Collection and Field and Laboratory Analysis
    - 5.2.1.3 Background, QA/QC, and Blank Samples and Frequency
  - 5.2.2 Field Procedures
    - 5.2.2.1 Drilling Methods and Equipment
    - 5.2.2.2 Materials (Casing, screen, etc.)
    - 5.2.2.3 Installation
    - 5.2.2.4 Sampling Methods
    - 5.2.2.5 Field Measurement Procedures and Criteria
    - 5.2.2.6 Documentation
- 5.3 Ground Water
  - 5.3.1 Rationale/Design
    - 5.3.1.1 Monitoring Well Location and Installation
    - 5.3.1.2 Sample Collection and Field and Laboratory Analysis
    - 5.3.1.3 Upgradient, QA/QC, and Blank Samples and Frequency
  - 5.3.2 Monitoring Well Installation
    - 5.3.2.1 Drilling Methods and Equipment
    - 5.3.2.2 Materials
      - 5.3.2.2.1 Casing/Screen/Centralizers
      - 5.3.2.2.2 Filter Pack, Bentonite Seal, Cement/Bentonite Grout
      - 5.3.2.2.3 Surface Completion
      - 5.3.2.2.4 Water Source
      - 5.3.2.2.5 Delivery, Storage, and Handling of Materials
    - 5.3.2.3 Installation
      - 5.3.2.3.1 Test Holes
      - 5.3.2.3.2 Soil Sampling and Rock Coring During Drilling
      - 5.3.2.3.3 Geophysical Logging

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Table 3-1 (Continued)

5.3.2.3.4 Borehole Diameter and Depth
5.3.2.3.5 Screen and Well Casing Placement
5.3.2.3.6 Filter Pack Placement
5.3.2.3.7 Bentonite Seal
5.3.2.3.8 Cement/Bentonite Grout Placement
5.3.2.3.9 Concrete/Gravel Pad Placement
5.3.2.3.10 Protective Cover Placement
5.3.2.3.11 Well Identification
5.3.2.3.12 Well Development
5.3.2.3.13 Well Survey
5.3.2.3.14 Alignment Testing
5.3.2.3.15 In Situ Permeability Testing
5.3.2.4 Documentation
5.3.2.4.1 Logs and Well Installation Diagrams
5.3.2.4.2 Development Records
5.3.2.4.3 Geophysical Logs
5.3.2.4.4 Decommission/Abandonment Records
5.3.2.4.5 Photographs
5.3.2.5 Well Decommission/Abandonment
5.3.2.6 Water Level Measurement
5.3.3 Determine Free Product Presence and Sampling
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5.3.9 Field Quality Control Sampling Procedures
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5.4.1.2 Discrete/Composite Soil Sampling Requirement
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5.5.1.2 Sediment Sample Locations from Onsite and/or Offsite Drainage Channels
5.5.1.3 Sediment Sample Locations from Ponds, Lakes, and Lagoons
5.5.1.4 Discrete/Composite Soil and/or Sediment Sampling Requirements
5.5.1.5 Sample Collection and Field and Laboratory Analysis
5.5.1.6 Upgradient, QA/QC, and Blank Samples and Frequency
5.5.2 Field Procedures
5.5.2.1 Sampling Methods for Surface Soil/Dry Sediment
5.5.2.2 Sampling Methods for Underwater Sediments from Ponds, Lakes, and Lagoons
5.5.2.3 Field Measurement Procedures and Criteria
5.5.2.4 Sampling for Physical/Geotechnical Analyses
5.5.2.5 Sampling for Chemical Analyses
5.5.2.6 Sample Containers and Preservation Techniques
5.5.2.7 Field QC Sampling Procedures
5.5.2.8 Decontamination Procedures

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Table 3-1 (Continued)

- 5.6 Surface Water
  - 5.6.1 Rationale/Design
    - 5.6.1.1 Surface Water Sample Locations
    - 5.6.1.2 Sample Collection and Field and Laboratory Analysis
    - 5.6.1.3 Upgradient, QA/QC, and Blank Samples and Frequency
  - 5.6.2 Field Procedures
    - 5.6.2.1 Sampling Methods for Surface Water - General
    - 5.6.2.2 Sample Handling Methods for Surface Water - Filtration
    - 5.6.2.3 Field Measurement Procedures and Criteria
    - 5.6.2.4 Sample Containers and Preservation Techniques
    - 5.6.2.5 Field Quality Control Sampling Procedures
    - 5.6.2.6 Decontamination Procedures
- 5.7 Other Matrices
  - 5.7.1 Rationale/Design
    - 5.7.1.1 Sample Locations
    - 5.7.1.2 Discrete/Composite Sampling Requirements
    - 5.7.1.3 Sample Collection and Field and Laboratory Analysis
    - 5.7.1.4 Background/Upgradient, QA/QC, and Blank Samples and Frequency
  - 5.7.2 Field Procedures
    - 5.7.2.1 Sampling Methods
    - 5.7.2.2 Field Measurement Procedures and Criteria
    - 5.7.2.3 Sample Containers and Preservation Techniques
    - 5.7.2.4 Field Quality Control Sampling Procedures
    - 5.7.2.5 Decontamination Procedures

6.0 Field Operations Documentation
- 6.1 Daily Quality Control Reports (QCR)
- 6.2 Field Logbook and/or Sample Field Sheets
- 6.3 Photographic Records
- 6.4 Sample Documentation
  - 6.4.1 Sample Numbering System
  - 6.4.2 Sample Labels and/or Tags
  - 6.4.3 Chain-of-Custody Records
- 6.5 Field Analytical Records
- 6.6 Documentation Procedures/Data Management and Retention

7.0 Sample Packaging and Shipping Requirements

8.0 Investigation-Derived Wastes (IDW)

9.0 Field Assessment/Three-Phase Inspection Procedures
- 9.1 Contractor Quality Control (CQC)
- 9.2 Sampling Apparatus and Field Instrumentation Checklist

10.0 Nonconformance/Corrective Actions

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II Quality Assurance Project Plan (QAPP)

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2.0 Data Assessment Organization and Responsibilities

3.0 DQO
- 3.1 Data Use Background
- 3.2 Measurement Quality Objectives for Chemical Data Measurement

4.0 Sample Receipt, Handling, Custody and Holding Time Requirements
- 4.1 Verification/Documentation of Cooler Receipt Condition
- 4.2 Corrective Action for Incoming Samples

5.0 Analytical Procedures
- 5.1 Preventive Maintenance
- 5.2 Calibration Procedures and Frequency

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5.3 Laboratory QC Procedures
5.3.1 Analytical Sequence QC
5.3.2 Batch/Matrix-Specific/Performance-Based QC
5.4 Performance and System Audits
5.5 Nonconformance/Corrective Actions
6.0 Data Reduction/Calculation of Data Quality Indicators
6.1 Precision
6.2 Bias
6.3 Sample Quantitation/Reporting Limits (Limit of Detection)
6.4 Completeness
7.0 Laboratory Operations Documentation
7.1 Sample Management Records
7.2 Data Reporting Procedures
7.2.1 Data Package Format and Contents
7.2.2 Electronic Deliverables
7.3 Data Management Procedures
7.3.1 Laboratory Turnaround Time
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8.0 Data Assessment Procedures
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8.2 Data Verification/Validation
8.3 DQO Reconciliation
8.4 Project Completeness Assessment

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B Standard Forms to be Used
C List of Abbreviations and Acronyms

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Data Quality Objectives Summary
Site Remedial Objectives
Previous Analytical Data Summary
Current Efforts Sampling and Analysis Summary
Proposed Monitoring Well Information
Sample Container Preservation and Holding Time Requirements
Names and Addresses of Owners of Property Near the Site
Sample Container Quantities
Summary of Sample Matrices and Locations
Summary of Number of Samples and Analyses

Example List of Figures

Site Location
Project Organization
Proposed Monitoring Well and Onsite Sample Locations
Proposed Offsite Sample Locations
Monitoring Well Construction
Investigation Schedule

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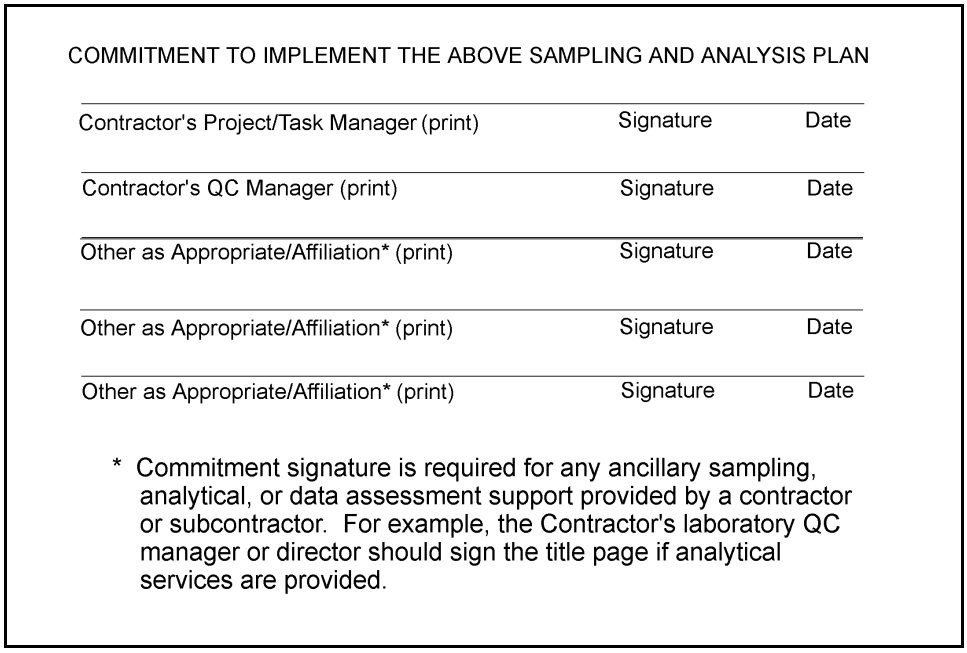
3.3 Content of Major Elements

The FSP describes the field activities to be performed and defines the procedures and methods that must be used to collect field measurements and samples. Issues include collection of geophysical data; drilling of soil borings; installation of ground water monitoring wells; and procedures for collection of multimedia samples, field control samples, and any field measurements. The FSP also addresses the sample packaging and shipping requirements, proper handling and disposal of investigation-derived wastes (IDWs), field documentation procedures, corrective action procedures, and the project schedule.

The QAPP focuses primarily on the analytical methods and QA/QC procedures that are used to analyze the samples and manage the data. The QAPP should include the organization and responsibilities of project laboratory and data assessment personnel; QA objectives; sample receipt, handling, custody, and holding time requirements; analytical procedures, equipment preventive maintenance, calibration, internal quality control procedures, and performance/system audits; data reduction, review, and reporting; and data assessment, data useability, and DQO reconciliation. The recommended requirements for the contents of FSPs and QAPPs are discussed in the following subsections. Additional information may be obtained from EPA QA/R-5, EPA QA/G-5, and other references provided in Appendix A.

3.3.1 Title page. The title page should be the first page of the SAP. The following items should appear on the title page: the name of the document, site name and location, USACE contract number (if applicable), regulatory authority under which the activities are being performed (CERCLA, RCRA, etc.), and date of preparation. If necessary, due to project modifications, the SAP may be assigned a document and/or revision number. If tasks performed under the SAP are executed by a contractor, Figure 3-1 is an example signature block that should appear at the bottom of the title page. If the recommended signatures are difficult to acquire, it is suggested that a statement be added that the approved SAP was provided to the appropriate parties (i.e., laboratories, drillers, data assessment personnel, etc.), identifying names of recipients and the date.



COMMITMENT TO IMPLEMENT THE ABOVE SAMPLING AND ANALYSIS PLAN

Contractor's Project/Task Manager (print)	Signature	Date
Contractor's QC Manager (print)	Signature	Date
Other as Appropriate/Affiliation* (print)	Signature	Date
Other as Appropriate/Affiliation* (print)	Signature	Date
Other as Appropriate/Affiliation* (print)	Signature	Date

* Commitment signature is required for any ancillary sampling, analytical, or data assessment support provided by a contractor or subcontractor. For example, the Contractor's laboratory QC manager or director should sign the title page if analytical services are provided.

Figure 3-1. Example signature block

3.3.2 Distribution list. This list should include all recipients of the SAP, and any addendums or modifications thereto.

3.3.3 Table of contents. This should be a very general table of contents that outlines the layout of the SAP. Table 3-2 is an example.

3.3.4 Field sampling plan (FSP). An FSP should include the following:

Table 3-2
SAP Table of Contents Example

Introduction

I Field Sampling Plan
Title Page
Table of Contents
1.0 Project Background
2.0 Project Organization and Responsibilities
3.0 Project Scope and Objectives
4.0 Nonmeasurement Data Acquisition
5.0 Field Activities by Area of Concern (AOC)
6.0 Field Operations Documentation
7.0 Sample Packaging and Shipping Requirements
8.0 Investigation-Derived Wastes (IDW)
9.0 Field Assessment/Three Phase Inspection Procedures
10.0 Nonconformance/Corrective Actions

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II Quality Assurance Project Plan
Title Page
Table of Contents
1.0 Project Laboratory Organization and Responsibilities
2.0 Data Assessment Organization and Responsibilities
3.0 Data Quality Objectives
4.0 Sample Receipt, Handling, Custody, and Holding Time Requirements
5.0 Analytical Procedures
6.0 Data Reduction/Calculation of Data Quality Indicators
7.0 Laboratory Operations Documentation
8.0 Data Assessment Procedures

Appendices

A References
B Standard Forms to be Used
C List of Abbreviations and Acronyms

3.3.4.1 Title page. The FSP should have an abbreviated title page that includes the name of the document (e.g., Phase I Remedial Investigation Field Sampling Plan), document and/or revision number, and the date it was prepared.

3.3.4.2 Table of contents. The table of contents should list the FSP elements, any appendices that are required to augment the FSP, tables, and figures.

3.3.4.3 Project background. This section of the FSP should be as specific as possible. Sufficient information should be included to permit a technical person unfamiliar with the project to evaluate the sampling and analytical approach presented. If items discussed here are in the project work plan, they do not need to be repeated, but they should be incorporated by reference. For those projects that do not require a work plan, refer to paragraph 1.7.1 for additional topics included within this section. This section of the FSP should include a description of the location, size, and important physical features of the site, such as ponds, lagoons, streams, and roads (a map showing the site location and layout would be helpful). A chronological site history including descriptions of the use of the site, complaints by neighbors, permitting, and use of chemicals should be provided. The historical data from previous sampling efforts at the site should be identified and summarized. An assessment of the quality of the historical data should be included as well as a discussion of problems previously encountered. The

effects of this information on the current project should also be discussed. This section should also describe the site problem to be resolved and the project approaches planned to work toward this resolution.

3.3.4.4 Project organization and responsibilities. This element of the FSP identifies key field personnel or organizations that are necessary for each field activity during the project. For remedial action and/or construction projects, this element will be expanded to include key personnel for all activities including project planning, since no overall project work plan is required. A table or chart showing the organization and lines of authority should be included. When specific personnel cannot be identified, the organization with the responsibility should be listed. The organization chart should also include all subcontractors and their key points of contact (POC). Separate organization charts for subcontractors may be referenced as needed. The organization chart should identify QC managers, including POCs of subcontractors, and should illustrate their relationship to other project personnel. The QC managers should be organizationally independent of the project management so that the risk of conflict of interest is minimized. This section of the FSP should also describe the responsibilities of all project field personnel, including sampling personnel, liaison between field and laboratory, and QC managers. It should designate responsibility for planning, coordination, sample collection, disposal of investigation-derived waste, and sample custody. This section should also identify any special training requirements and/or personnel certifications necessary to perform the project work.

3.3.4.5 Project scope and objectives. This section should identify the project activities planned, incorporating QA elements to be implemented to support those activities, any relevant regulatory standards, and the project schedule. EM 200-1-6 provides information on the QA elements that may be used for project chemical data quality assessment. Project QA procedures include laboratory validation, field and laboratory audits, PE samples, data validation procedures, etc. The project assessment activities employed should be discussed as they pertain to the general QA objectives identified for the project. Specific objectives of a sampling effort that describe the intended use of data should be clearly and succinctly stated. These objectives should satisfy not only the intended uses of the data, but also applicable regulatory standards or client preferences. This section of the FSP should also discuss special situations where site access may need to be obtained from private property owners, if applicable. In addition, an outline should be included of the project schedule based on client and regulatory requirements. Items listed on the project schedule should include project plan review periods, easement/permit periods, fieldwork, sample analysis, data management and validation, and project report writing.

3.3.4.6 Nonmeasurement data acquisition. This section of the FSP should describe those data needed from nonmeasurement sources. This may include information obtained from databases, literature, handbooks, local planning authorities, and other specific organizations. Information of this type may be needed to support risk assessment (local relevant or significant habitats, endangered species, future land uses, and well surveys); geological data (site bedrock formations, soil series); hydrogeological data (local or regional aquifers); meteorological data; data supporting modeling activities, etc.

3.3.4.7 Field activities by area of concern (AOC). This section of the FSP discusses the field activities planned for the work effort. For ease of review and referencing, it is recommended recommend that the SAP field activities be organized by area of concern (AOC) initially, with applicable matrices for that area managed as subsections.

3.3.4.7.1 Rationale/design. This section of the FSP discusses the rationale for each of the field activities. Each subsection that describes the matrices to be sampled within the AOC should include the

rationale behind the required number of field samples; the strategy (statistical, judgmental, and/or random basis) for selecting the particular sampling location (as discussed in Instruction C-1, Appendix C); a summary of the estimated or required number of field, background/upgradient, and field control samples; whether temporal changes can affect the representativeness of the sample; and the type of samples (composite or discrete). If a grid pattern is to be used to locate sample points, a discussion of the grid dimensions and layout should be included. Procedures should be defined for how sample locations are to be marked for future reference. As an alternative to the prescriptive approach of defining sample numbers and locations, is developing a decision logic that is used in conjunction with field analytical results to support onsite decision-making on the progress and direction of subsequent site sampling activities. Maps should be included to present site/AOC boundaries, any significant features, onsite buildings, ground water flow, existing monitoring wells, proposed sampling points, and any known contamination or plumes.

3.3.4.7.2 This FSP section should also discuss the analytical protocol and the rationale on how that relates to the site history and objectives of the work effort. Note any relevant action or decision levels. Also note when analytical protocols will change or differ within the same matrix, and the rationale for this approach. For instance, when based upon preliminary results, subsequent sample analytical protocols are abbreviated, or target compound lists are short-listed. The use of tables is suggested to present the information on sample analytical protocols, including appropriate analytical method numbers. Reference the QAPP portion of the SAP for details on method target analyte lists, sensitivity requirements (detection and quantitation limits), holding times, etc. Refer to Appendix I for details on analytical chemistry requirements. This FSP section should also list all field measurements that will be made during the project, noting the field analytical technologies, the protocols used, and the onsite decisions that the field data will support. Attach all field analytical method SOPs to the SAP. Identify the site-specific indicator compounds to be monitored, which samples will undergo field analyses, and how the data will be used / applied to a decision logic, or the effect on the sampling scheme this data will have. For instance, field screening data may direct samples for offsite definitive analysis, may define an appropriate low-level or high-level analytical method, or may be used to supplement a larger data set from which to support project decisions. Depending on the intended use of the field data, comparability to a definitive analysis may be an important factor and should be discussed with data users. Recommend performing bench or pilot studies, field trials, or establishing interim milestones early in the work effort to compare the field analytical results to definitive results to assess the correlation between the techniques and the viability of the field analytical technique. Further recommend that a percentage of field analyzed samples undergo redundant definitive analysis throughout the project to update the correlation, accuracy, and precision goals of the field analytical technique based on data's use. Verification should encompass samples that cover the entire range of contamination found onsite. Refer to Appendix H for details on field analysis technologies implementation. The discussion of field control samples should include the objective and rationale for these samples (how the data will be used), as well as the location and frequency for collecting/submitting these samples. This may include QA and QC duplicates, matrix spike/matrix spike duplicates, double-blind PE samples, equipment blanks, and/or trip blanks. This frequency may be expressed as a definitive number or percentage of the total number of samples collected. The sample locations may be identified qualitatively (e.g., the samples anticipated or noted as most contaminated) or by a specific area or sample location. Refer to Instruction G-2, Appendix G, for information on field control samples that may be used to assess field activities. It is recommended that all field samples and field control samples planned be summarized in tabular form. This table should indicate by sample location or area of concern the total number of samples for each matrix and associated QA/QC samples. For projects involving a large number of samples or analyses, it may not be possible to include all matrices in a single table. For such cases, two or more tables may be necessary. Table 3-3 is an example of a subsurface soil sample summary table.

Table 3-3
Sample Summary Table for Subsurface Soils

Sample Location	Sample Depth[1]	Sample Number (Primary Lab)	QC Sample Number (Primary Lab)	Associated Trip Blank Number (Primary Lab)	Associated Rinsate Blank (Primary Lab)	Sample Number (QA Lab)	Associated Trip Blank Number (QA Lab)	Associated Rinsate Blank (QA Lab)	EPA 8260[2]	EPA 8270[2]	EPA 6010[2]	EPA 8081[2]
T-1	4-6 ft bgs	T-1	-	TB-1	RB-1	-	-	-	X	X	X	X
T-2	6-8 ft bgs	T-2	-	TB-1	RB-1	-	-	-	X	X	X	X
T-3	2-4 ft bgs	T-3/S-1	T-6/S-1	TB-1	RB-1	T-6/S-1/QA	TB-1/QA	RB-1/QA	X	X	X	X
	4-8 ft bgs	T-3/S-2	-	TB-1	RB-1	-	-	-	X	X	X	-
	8-12 ft bgs	T-3/S-3	-	TB-1	-	-	-	-	X	-	-	-
T-4	6-8 ft bgs	T-4	-	TB-2	RB-1	-	-	-	X	X	X	X
T-5	2-4 ft bgs	T-5/S-1	T-7/S-1	TB-2	RB-1	T-7/S-1/QA	TB-2/QA	RB-1/QA	X	X	X	X
	4-8 ft bgs	T-5/S-2	-	TB-2	RB-1	-	-	-	X	X	X	-
	8-12 ft bgs	T-5/S-3	-	TB-2	-	-	-	-	X	-	-	-
T-11	6-8 ft bgs	T-11	-	TB-2	RB-1	-	-	-	X	X	X	X
T-14	6-8 ft bgs	T-14	-	TB-2	RB-2	-	-	-	X	X	X	X
T-23	2-4 ft bgs	T-23	-	TB-2	RB-2	-	-	-	X	X	X	X

Notes: 1. The spatial relationship of sample and blank numbers in the table is important. This design of the sample numbers themselves is not required. However, duplicate samples must be blind to the primary laboratory.
2. USACE policy does not require trip or rinstate blanks for soil sampling activities, but allows for them if project-specific considerations warrant.
3. This table should be prepared prior to field activities and included in the SAP. The table prepared after field activities would document any deviation from the plan.

[1] bgs = below ground surface.
[2] The most recently promulgated versions of these methods taken from EPA/SW-846 must be used.

3.3.4.7.3 Field procedures. This section of the FSP addresses the field procedures for sampling each matrix within an AOC and should include a description of the sampling equipment (including material it is constructed of), any special conditions that are required for the preparation or installation of that sampling equipment, field measurements, sample collection, sample handling, sample packaging (including sample containers and preservatives), and equipment decontamination. Sample handling procedures may encompass techniques for compositing subsamples (define number of subsamples, grid patterns, etc.), homogenizing solid matrices, splitting of replicate samples, filtering aqueous matrices, or the special handling of solid samples for volatile organic compounds (VOC) analysis. Any special care in sample handling to avoid cross-contamination or unnecessary loss or degradation of contaminants should be defined. The use of maps, figures, charts, flow diagrams, or tables is recommended to clearly delineate a sampling program. Provide tables for identification of appropriate sample container numbers, types, and sizes by matrix/chemical parameter; preservatives; and analytical holding times. Also note when two or more sample analyses may be combined into one sample container. Relevant SOPs should be included within the SAP to identify appropriate step-by-step procedures for sample acquisition, handling, and packaging. Refer to the tables and instructions/SOPs included within Appendices B and E for additional guidance on these subjects. This section of the FSP should also include field analysis procedures for calibration and analysis, the acceptance criteria, and the required actions based on the field results. The specifications and requirements for field instrumentation, including the initial and continuing calibration, calibration verification, maintenance and inspection schedules, any factors that limit use of the equipment, as well as the requirements for field data evaluation and reporting must be outlined in the FSP. Table 3-4 is an example of a field instrument calibration table that may be used on projects. Finally, each section should discuss any time constraints or other difficulties with sending samples to the laboratory. Specify contingencies in the event of delays and/or slippage in the schedule. Additional information on field activity procedures is presented in the following subsections and in Appendices C, D, and E by individual matrices or sample handling technique.

Table 3-4
Field Instrument Calibration Table

Instrument Manufacturer	Analyzer Name	Detector	Chemical Parameter[1]	Calibration Requirement[2]	Performance Checks[3]
--	--	Photoionization	Total Ionizable Hydrocarbons	Daily	None
--	--	Flame ionization	VOC	Per measurement	Weekly
--	--	Ultraviolet	SO_2	Weekly	Zero, Span, Drift, etc.
--	--	Foil	Dissolved O_2	Daily	Calibration Check

[1] Compound, Analyte, or Detector Response.
[2] Calibrator Source, such as Hexane, Reference Material, etc.
[3] Frequency of Zero, Span, Response Time, Calibration Check, etc.

3.3.4.7.4 Geophysics. This section of the FSP should include a discussion of the objectives of geophysical analysis and the techniques proposed to meet these objectives. It should also address general topics discussed in Paragraphs 3.3.4.7.1 and 3.3.4.7.2, as appropriate. The discussion should include the rationale used to delineate the study area and determine the spacing for the geophysical measurements. The proposed equipment, equipment calibration, and quality control procedures; preliminary testing of the method employed and early termination procedures; reporting requirements; delineation of the area to be investigated; data processing; and interpretation of the data should also be included. Refer to EM 1110-1-1802, Geophysical Exploration for Engineering and Environmental Investigations, for the required information covering geophysical surveys.

3.3.4.7.5 Soil gas survey. This section of the FSP should define the type of soil gas survey to be performed (active or passive); provide a discussion of the objectives of the survey and the rationale for selecting the location and frequency of soil gas samples; define the equipment and methods used for drilling, the materials (casing, screen, etc.), and the installation methods, sampling methods, documentation requirements, and any of the general topics discussed in paragraphs 3.3.4.7.1 and 3.3.4.7.2 above. Refer to Instruction C-8, Appendix C, for further information on soil gas sampling.

3.3.4.7.6 Ground water. This section of the FSP should include a discussion of the objectives for ground water sampling, monitoring well location rationale (e.g., to determine ground water flows, identify upgradient contaminant sources) and the rationale for screen depth placement. Methods for monitoring well installation should be discussed and/or relevant SOPs attached to the SAP, including design construction details, procedures for well development and well purging, obtaining a water level measurement or determining if free product is present, aquifer testing and any field measurements, defining required pumps, filters, drilling and sampling equipment decontamination procedures, and well development and/or purge water disposal requirements. Also, refer to paragraphs 3.3.4.7.1 and 3.3.4.7.2 for additional topics to be addressed. It is suggested that this section of the FSP include a table to summarize the well depths, casing diameters, screen intervals, etc., for new and existing monitoring wells to be sampled. Additional language should be presented within the FSP to discuss whether free product is anticipated and the effect that may have on the sampling event. Refer to EM 1110-1-4000 for required information on installation of ground water monitoring wells at HTRW sites and Instruction C-2, Appendix C, for more information on ground water sampling.

3.3.4.7.7 Ground water filtration. There are diverse views on the filtration of ground water before sample preservation for metals analysis. Many regulatory programs no longer accept filtered samples as representative of "dissolved metal" concentrations. Studies also indicate that the results from unfiltered samples may be affected more by well installation and development procedures than ground water contamination present. Options include filtering; not filtering; or the use of alternative sampling techniques (i.e., low-flow sampling techniques). The option selected should be based on the objectives of the specific project including the acquisition of samples representative of aquifer geochemistry and contamination, the intended use of the analytical data, comparability with previous site results, and the position of the regulators. Since metals that are attached to soil particles present during digestion will also be detected, higher metal concentrations are typical for the unfiltered ground water sample than for the filtered sample. However, carbon dioxide and oxygen concentrations may change over time once a ground water sample has been taken. This may lead to changes in pH and Eh, which in turn may lead to the precipitation of metal species. Therefore, delayed filtration may result in the precipitation of metals, which are then filtered, resulting in even lower dissolved metals concentrations. For this reason, filtration of samples, if specified, should be performed shortly after collection within the field, preferably using an in-line system, in lieu of having the laboratory perform this procedure. Field filtration procedures must be conducted prior to sample preservation (acidification), and both should be performed prior to sample shipment. Instructions C-2 and E-1, found in Appendices C and E, respectively, contain additional information on ground water sampling and filtration techniques. Refer to EPA 540/4-89/001 and Heidlauf and Bartlett (1993) for additional information on this topic. An alternative procedure to filtering samples is the use of a low-flow (minimal drawdown) sampling technique for sample acquisition (see EPA 540/S-95/504). This technique is the preferred method to obtain representative ground water samples, especially for redox sensitive analytes such as chromium. In addition to obtaining a sample that has both the dissolved and natural colloidal fraction of the ground water, the amount of purging and investigation-derived waste can be minimized. This method requires the use of an appropriate pump and a flow-through cell with a multiparameter probe (dissolved oxygen, pH, oxidation-reduction potential, temperature, total dissolved solids, and turbidity). There is also less agitation of the sampled media with

this technique; therefore it is a preferred method for the collection of volatile samples. Refer to Instruction C-2, Appendix C, for further information on low-flow sampling techniques.

3.3.4.7.8 Subsurface soil. This section of the FSP should discuss the objectives of subsurface soil samples and the rationale for soil boring locations, note discrete and/or composite sampling, and discuss any field analytical parameters to be measured. When compositing of samples is done, define the size and shape of the grid pattern and number of subsamples to be combined. This section should also discuss drilling methods, sampling methods for physical and chemical analyses, decontamination procedures of the drilling equipment, documentation and logging procedures, and the general topics discussed in paragraphs 3.3.4.7.1 and 3.3.4.7.2. Documentation of soil boring information is required in order to log facts into the Geospatial Data System as outlined within Instruction F-1, Appendix F. Additional information on subsurface soil sampling procedures is presented in Instruction C-6, Appendix C, and in EM 1110-1-1906.

3.3.4.7.9 Surface soil and sediment. This section of the FSP should discuss objectives of surface soil and/or sediment samples, the rationale for location and frequency of discrete and/or composite samples, all procedures required for collecting samples, and any applicable topics from paragraphs 3.3.4.7.1 and 3.3.4.7.2. When compositing of samples is done, define the size and shape of the grid pattern and number of subsamples to be combined. Instructions C-5 and C-6 in Appendix C contain additional information on sampling of sediments and surface soils.

3.3.4.7.10 Surface water. This section of the FSP should discuss the objectives and types of surface water or surface water runoff to be sampled, the rationale for the location and frequency of these samples, all procedures required for collecting surface water samples, and any applicable topics identified in paragraphs 3.3.4.7.1 and 3.3.4.7.2. Instruction C-3, Appendix C, contains additional information on the sampling of surface water and/or surface water runoff.

3.3.4.7.11 Other matrices. This section of the FSP should discuss the rationale for the location and frequency of samples from other matrices and the general topics discussed in paragraphs 3.3.4.7.1 and 3.3.4.7.2. Examples of other matrices include perimeter or point-source air samples, various media (solid, liquid, or gas) from remedial process waste streams, potable water supplies, surficial samples, bulk materials, etc. Appendices C and D contain information on sampling other matrices.

3.3.4.8 Field operations documentation. This section of the FSP should identify the records used to document all field operations. The FSP should also identify the records and schedule for those which require periodic submittal to a USACE representative. Project records may include the daily contractor QC reports, field logbook, field sheets, or other logs (i.e., boring logs, well installation diagrams, well development forms), any photographic records, and any field analytical records. This section should also address the sample documentation records, such as the sample numbering system, sample labels, tags, or sample field sheets, chain-of-custody forms, custody seals, and lab notification sheets. Corrections to documentation entries must be defined according to procedures identified in paragraph F-1, Appendix F. Include all proposed forms and tables within this section of the project FSP. Custody requirements for the samples should be defined, as applicable, during sample collection, transfer, and within the laboratory. Custody requirements should also be established for the final evidence papers of the project. This includes all originals of field documentation and laboratory reports. Also define records management practices, such as review procedures and record retention requirements. Other records may also be included within this section, such as SOPs, corrective action reports, any manifesting, bills of lading, waste profile forms, test pit logs, drum log sheets, etc. Refer to Instruction F-1, Appendix F, for additional information on documentation.

3.3.4.9 Sample packaging and shipping requirements. This section of the FSP should include a discussion of sample packaging and shipping requirements in accordance with U.S. Department of Transportation regulations. Identify all appropriate laboratories, noting addresses and points of contact; a schedule for submitting samples; the mode of sample transportation (e.g., overnight courier); and any manifesting requirements for the shipment. A checklist is recommended to verify completeness of sample shipment preparations. An example facsimile of a checklist for shipping HTRW samples is presented in Figure 3-2. It is recommended that the receiving laboratories also document the condition of field samples upon receipt at the laboratory. This enables verification of correct sample volumes, sample preservation, cooler temperature, chain-of-custody completeness and accuracy, and overall packaging techniques. An example facsimile of a cooler receipt documentation is presented in Figure 3-3. Another document beneficial to the laboratory by providing information on sample custody, preparatory/analysis methods, and data reporting requirements is the Laboratory Notification Checklist (LNC). It is recommended that the LNC be prepared and forwarded to the lab with the approved SAP, and a copy accompany the first shipment of incoming samples to the primary and referee (QA) laboratories. A facsimile of the LNC is presented in Figure 3-4. Instruction F-2, Appendix F, gives more information on sample packaging and shipping procedures; and sample receipt/log-in procedures are noted in paragraph I.5.1, Appendix I.

3.3.4.10 Investigation-derived wastes (IDW). This section of the FSP should discuss the procedures for collecting, labeling, storing, and disposing of the IDW. The procedures for assessing corresponding sample results or sampling the IDW to determine whether it is hazardous should be explained. Finally, the discussion should address how the sample results will be evaluated to determine disposal options for the IDW. It is important to note that disposal actions must be conducted with the concurrence of appropriate USACE technical personnel and that the final disposal decision must be agreed to by all parties.

3.3.4.11 Field assessment/three-phase inspection procedures. The contractor is required to ensure that quality is maintained throughout all field work by means of a three-phase control process (Engineer Regulation (ER) 1180-1-6 and Corps of Engineers Guide Specifications (CEGS) 01450 and 01451). Contractor quality control (CQC) phases (preparatory, initial, and follow-up) are performed onsite by a contractor-assigned QC officer whether or not a Government representative is present. The Contractor will summarize the activities of each CQC phase in the daily QC report. The CQC phases are performed for each definable feature of work. A definable feature is a task that is separate and distinct from other tasks and has separate control requirements. For example, the definable features of the sample collection task include, at a minimum, each matrix (air, water, soil, containerized waste, etc.). This section of the FSP should contain the contractor's detailed plans for implementing the CQC process, including identification of the CQC representative; listing of field equipment; description of activities during the phases; identification of the definable features of work; and generation of a sample table that will be used to match up primary and QA samples, as well as other field control samples required for the project. Paragraph G-1 in Appendix G contains additional information and checklists to help plan the preparatory and initial phases, and Table 3-3 is an example of a sample summary table. The equipment list noted may also be used by USACE QA personnel to support their preparatory phase inspection procedures of CQC. For USACE in-house projects, this section will include a list of the field equipment that will be required to perform the field activities and a sample table that correlates field samples to the appropriate field control (QA/QC) samples.

3.3.4.12 Nonconformance/corrective actions. The FSP should include corrective action procedures to be taken in the event a discrepancy is discovered by field personnel or during a desk or field audit, or the laboratory discovers discrepancies or problems. Typical discrepancies or problems include but are not limited to improper sampling procedures, improper instrument calibration procedures, incomplete or improper sample preservation, and problems with samples upon receipt at the laboratory.

SHIPPING CONTAINER CHECKLIST SUMMARY

ATTN.: Corps of Engineers Contractors

Failure to properly handle or document the Project samples could jeopardize the useability of the sample results and ultimately the project. Prior to sending this cooler to the Analytical Laboratory at the address shown below, please check the following items:

- Is the project clearly identified on the Chain-of-Custody (official project name, project location, project phase)? Is the United States Army Corps of Engineers project number from the Sampling and Analysis Plan clearly indicated on the Chain-of-Custody?
- Are all enclosed sample containers clearly labeled with waterproof (permanent) ink and enclosed in a plastic bag?
- Are the desired analyses indicated on the bottle labels and chain-of-custody? Are the metals defined on the Chain-of-Custody (e.g., metals = lead, cadmium, etc.)?
- Are the sample labels complete, including the identification of appropriate method numbers for both the preparatory and analysis procedures?
- Does the information on the Chain-of-Custody match the information on the sample container labels?
- Have you placed the Chain-of-Custody in a plastic bag and attached it to the inside of the cooler lid?
- Have the samples been properly preserved (acid or base and cooling to 4°C ± 2 °C)?
- Is there a Contractor point of contact including name and phone number clearly shown on the Chain-of-Custody?
- Is there sufficient ice (double bagged in zip-locks) or "blue ice" in the cooler? It is recommended that the samples be placed on ice as soon as possible after sampling and repacked on new ice in shipping cooler.

This is a partial list of the requirements for proper documentation and shipping of the environmental samples. Please refer to the Sampling and Analysis Plan for further details.

Figure 3-2. Shipping container checklist

COOLER RECEIPT FORM Contractor Cooler_____

LIMS#_____ QA Lab Cooler #_____

Number of Coolers_____

PROJECT:_____ Date received:_____

USE BOTTOM OF PAGE 2 OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler was opened: _____
by (print)_____ (sign)_____

1. Did cooler come with a shipping slip (air bill, etc.)? . . . . . YES NO
   If YES, enter carrier name & air bill number here: _____

2. Were custody seals on outside of cooler? . . . . . YES NO
   How many & where _____, seal date: _____ seal name:_____

3. Were custody seals unbroken and intact at the date and time of arrival? . . . . . YES NO

4. Did you screen samples for radioactivity using the Geiger counter? . . . . . YES NO

5. Were custody papers in a plastic bag & taped inside to the lid? . . . . . YES NO

6. Were custody papers filled out properly (ink, signed, etc.)? . . . . . YES NO

7. Did you sign custody papers in the appropriate place? . . . . . YES NO

8. Was the project identifiable from custody papers? If YES, enter project name at the top of this form . . . . . YES NO

9. Were temperature blanks used? . . . . . YES NO
   Cooler Temperature_____(°C) Thermometer ID No._____

10. Have designated person initial here to acknowledge receipt of cooler: _____ (date) _____

(Continued)

Figure 3-3. Cooler receipt checklist (Note: LIMS = Laboratory Information Management System) (Continued)

B. LOG-IN PHASE: Date samples were logged in: _____
by (print) _____ (sign) _____

11.	Describe type of packing in cooler: _____		
12.	Were all bottles sealed in separate plastic bags?	YES	NO
13.	Did all bottles arrive unbroken with labels in good condition?	YES	NO
14.	Were all bottle labels complete (ID, date, time, signature, preservative, etc.)?	YES	NO
15.	Did all bottle labels agree with custody papers?	YES	NO
16.	Were correct containers used for the tests indicated?	YES	NO
17.	Were samples preserved to correct pH, if applicable?	YES	NO
18.	Was a sufficient amount of sample sent for tests indicated?	YES	NO
19.	Were bubbles absent in volatile organic analysis (VOA) samples? If NO, list VOA samples below	YES	NO
20.	Was the project manager called and status discussed? If YES, give details on the bottom of this form	YES	NO
20.	Who was called? _____ By whom? _____ (date)_____		

Figure 3-3. (Concluded)

LABORATORY NOTIFICATION CHECKLIST

1. Project Name/Location: _____
2. Project Plans Title, Revision Number, and Date: _____
3. Contract Number: _____
4. Data Quality Objectives (DQOs) Summary (intended use of data): _____

_____

5. Lab Specific DQOs (Data quality indicators acceptance limits): _____

_____

6. Name of Person to be Contacted if there are Problems with the Sample Shipment:

_____

Phone Number: _____

FAX Number: _____

6. Name and Address of the Contract/QA Laboratories: _____
8. Project-Specific Requirements

Data Package Turn-Around Time: _____

Sample Retention Time Post-Analysis: _____

Sample Disposition Requirements: _____

MATRIX	SAMPLE NUMBERS	METHODS			REPORTING LIMITS (refer. SAP)
		PREP	CLEANUP	ANALYSIS	

9. Any Special Requirements (i.e., unusual target analytes, sample quick turnaround time (TAT)):

Figure 3-4. Laboratory notification checklist

3.3.5 Quality assurance project plan (QAPP). The following paragraph briefly describes the minimum requirements of a QAPP.

3.3.5.1 Title page. The title page should include the name of the document, (e.g., Phase I Remedial Investigation Quality Assurance Project Plan) and the date it was prepared. The contractor's laboratory QA manager or director should sign the title page if analytical services are provided. This will ensure that the laboratory is aware of the analytical methods employed and the measurement quality objectives for precision, bias, representativeness, completeness, comparability, and sensitivity. If the recommended signatures are difficult to acquire, suggest a statement be added that the approved SAP was provided to the appropriate parties and identify names of recipients and the date.

3.3.5.2 Table of contents. The table of contents should list the QAPP elements, any appendices that are required to augment the QAPP, and the titles of figures and tables. At the end of the table of contents the recipients of official copies of the QAPP should be listed.

3.3.5.3 Project laboratory organization and responsibilities. This element of the QAPP identifies key laboratory personnel or organizations that are necessary for each analytical activity during the study. All laboratories involved should be identified within this section, including the primary and referee (QA) laboratories. A table or chart showing the organization and lines of authority should be included. When specific personnel cannot be identified, the organization with the responsibility should be listed. The organization chart should also include all subcontractors and their key points of contact. Separate organization charts for subcontractors may also be needed. The organization chart should identify QA managers, including those of subcontractors, and should illustrate their relationship to other project personnel. The QA managers should be organizationally independent of project management so that the risk of conflict of interest is minimized. Requirements for the contractor's laboratory and laboratory personnel are located in Appendix I.4.3.

3.3.5.4 Data assessment organization and responsibilities. This element of the QAPP identifies personnel or organizations that will be performing data assessment activities. Applicable duties of personnel should be identified, and may include data review, verification, and/or validation procedures. A table or chart showing the organization and lines of authority and communication should be included. Refer to EM 200-1-6 for further information on data assessment procedures available.

3.3.5.5 Data quality objectives. Data quality objectives should be identified within this section to define the intended use of the data, and any specific conditions, criteria, or limits to be applied to the data based upon this use. Specific information to be included is outlined in the following sections.

3.3.5.5.1 Data use background. This section should highlight project-specific data needs that have been identified for the project, short-term decisions that will be made during the project planning phase, and long-term decisions that will be made prior to project closeout. A brief summary of the type of samples (media) and analyses (screening versus definitive, and applicable chemical parameters) that will be required to meet the data needs should also be included in this section. Refer to Sections I.3.1 and I.3.1.2 for a discussion of background information to be included in this section of the QAPP.

3.3.5.5.2 Measurement quality objectives for chemical data measurement. This section should describe the QA elements to be applied to the project to ensure proper CDQM. In addition, measurement quality objectives (MQOs) are established for key data quality indicator terms (precision, accuracy, sensitivity, etc.) to evaluate these QA elements for each matrix and analytical method. Refer to EM 200-1-6 for information on QA elements; and Appendix I for discussions on data quality indicators, MQOs,

and baseline method performance objectives. A cooperative effort should be undertaken by USACE, the lead agency, the contractor, and the laboratory staff when defining the project-specific MQOs required for the data. They should be based on a common understanding of the intended use of the data, available laboratory procedures, and available resources. However, these objectives should be defined in terms of project requirements, not in terms of the capabilities of the test methods. In addition, sensitivity (detection limits) expressed within a method are often based on a reagent water matrix and may not be achievable within an environmental matrix. However, when the requirements for the project are defined, the quality requirements established by the data user, the complexity of the media to be analyzed, the potential for interferences, etc., must be considered. This section should also address whether precision is being applied to field activities, to assess the laboratory performance, or both. Separate precision goals should be established for grab samples of a heterogeneous media (i.e., soil VOC samples). However, when sample handling techniques used are the same (i.e., field and laboratory duplicates of aqueous or homogenized soils), a separate criterion is not necessary. Because precision and bias can be measured in various ways, the calculation to be used should be identified. Completeness goals must be defined quantitatively, and whether it is being applied to individual samples, or for the work effort as a whole. Refer to Appendix I for further information on the remaining parameters of representativeness, comparability, and sensitivity. The use of tables to define the appropriate MQOs for each analytical method is recommended. Appendix I includes summary tables with default values that may be used verbatim, or changed to reflect project-specific DQOs. Due to the limited applications where the implementation of an EPA standard method is mandatory, these MQOs must be specified directly within the QAPP verbatim or by reference to ensure application to the project sample analyses. If the project MQOs are unattainable by available methods, either the methods or test plan must be compensated for these deficiencies. The following statements are examples of descriptions for precision and bias:

- Field precision objectives for the soil VOC samples are presented as relative percent difference of field duplicates and are presented within the attached tables. Any exceedance of the MQO values will trigger corrective action requirements as noted in Appendix I.

- Bias objectives for organic compounds are given as a percent recovery range of all target analytes within the laboratory control sample and matrix spikes, and as surrogate compounds in all field and QC samples. Bias goals are established by calculation of percent recovery, and are presented within the attached tables. Any exceedance of the MQO values will trigger corrective action requirements as noted within Appendix I.

3.3.5.6 Sample receipt, handling, custody, and holding time requirements. This section should identify the requirements for sample receipt condition verification, sample storage and/or handling requirements, any intralaboratory custody requirements, and analytical parameter holding times. In addition, all notifications, customer correspondence, and corrective actions for incoming samples must be thoroughly documented and available for review.

3.3.5.7 Analytical procedures. This section of the QAPP identifies the appropriate analytical test methods to be used for each environmental sample. The applicability of an individual method will be dependent upon the regulatory authority and the level of data quality required to support the data needs and decisions of the project. Applicable regulations that mandate the use of certain methods for any of the sample matrices and parameters listed in the project description should be specified. The use of tables is recommended to present this information clearly. It is suggested that the table be divided into each AOC, with proposed chemical parameters (including preparatory and analytical method numbers) defined for each matrix to be sampled within that area. Analytical chemistry requirements are presented in Appendix I.

3.3.5.7.1 Preventive maintenance. This section of the QAPP should discuss the laboratory's preventive maintenance plan that will be implemented to minimize downtime of laboratory instruments. If appropriate for the project, include a reference to Appendix I in order to apply the requirements specified therein.

3.3.5.7.2 Calibration procedures and frequencies. This section of the QAPP discusses the calibration procedures that are to be used by the contractor's laboratory. Issues that should be addressed in this section include defining the number and concentration of calibration standards to be used, the calibration range, and the procedures used to establish and verify the calibration of the laboratory's instruments. If appropriate for the project, include a reference to Appendix I in order to apply the requirements specified therein.

3.3.5.7.3 Laboratory QC procedures. This section of the QAPP identifies the specific internal QC measures to be used by the laboratory when performing the analytical tests. Type and frequencies of specific QC samples performed by the laboratory are dependent upon the specified analytical method. Internal QC methods require performance on a sample batch basis and include analyses of method blanks, laboratory control samples, and actual environmental samples as duplicates, matrix spikes, and matrix spike duplicates. Additional QC is incorporated into the analytical sequence. A more detailed discussion of internal QC procedures is presented in Appendix I. If appropriate for the project, include a reference to Appendix I in order to apply the requirements specified therein.

3.3.5.7.4 Performance/system audits. This section of the QAPP describes the performance and system audits that will be performed onsite and at the contractor's laboratory. The laboratory audits are typically conducted internally by the laboratory QA staff, as well as by external agencies. USACE performs laboratory audits in conjunction with the laboratory validation process. District personnel are encouraged to perform precontract or preaward system audits of the laboratory to ensure that proper communication and awareness of project DQOs are in place.

3.3.5.7.5 Nonconformance/corrective actions. This section of the QAPP addresses corrective actions that must be implemented if MQOs are not met. The QAPP should discuss corrective action procedures that will be implemented if problems are observed with incoming samples, sample holding times, instrument calibration procedures, specified detection and quantitation limits, or internal QC samples. Corrective actions may include resampling, reanalyzing samples, or auditing laboratory procedures. The QAPP should identify persons responsible for initiating these actions. It should also contain procedures for identifying and documenting corrective actions and procedures for reporting and follow-up of corrective actions. A more detailed discussion of corrective action procedures is contained in Appendix I. If appropriate for the project, include a reference to Appendix I in order to apply the requirements specified therein.

3.3.5.8 Data reduction/calculation of data quality indicators. This section of the QAPP should discuss how data are reduced by the laboratory and define how the precision, bias, sensitivity parameters (detection, quantitation, and reporting limits), and completeness goals are to be calculated from the project data. Data reduction procedures must be summarized and the persons responsible for data reduction must be identified. A more detailed discussion of the methods used to calculate these data quality indicators is presented in Appendix I.

3.3.5.9 Laboratory operations documentation. This section of the QAPP discusses the data reporting procedures for the project. The reporting package format, contents, reporting schedule, data archival, and records retention requirements should be identified. Any electronic data deliverables

format and technical content must be identified here also. Refer to Appendix I for information on the potential content requirements for screening, definitive, performance-based, and comprehensive data packages. For projects that involve a substantial number of samples, or projects that require continued monitoring, the use of interim data deliverables for reporting is recommended. These deliverables should be submitted after a proposed milestone instead of at the project completion.

3.3.5.10 Data assessment procedures. This section of the QAPP discusses the data review, verification, or validation process that is required to assure the validity of the data. It also discusses the DQO reconciliation process and the effect that it has on the final assessment of project completeness. Refer to EM 200-1-6 for further information on data assessment procedures.

3.3.5.10.1 Data QC review. The data review process should be discussed. Personnel who will have the various roles and responsibilities must be addressed in detail. The use of diagrams is suggested to outline the flow of the data as the project progresses.

3.3.5.10.2 Data verification/validation. The project requirements for data verification or validation must be defined. Terms used (i.e., validation) and procedures for implementation must be clearly defined in order to avoid any confusion on the anticipated level of effort for this task. A discussion of these terms, i.e., data review, validation, etc., and their requirements are presented in EM 200-1-6. Based on the project data use, implementation of an independent validation of the data may be necessary. Provide details on the percentage of data undergoing the validation process, and the procedures to follow. Refer to other USACE guidance for procedures for performance-based review, and validation procedures to encompass a manual full data validation for common EPA SW-846 methods.

3.3.5.10.3 DQO reconciliation. DQO reconciliation procedures should be identified. Details must be included that identify the personnel responsible for these tasks (contractor and/or USACE), the procedures to follow, any statistical tests to be employed, etc. DQO reconciliation is generally discussed in EM 200-1-2 and EM 200-1-6. Further guidance on this subject may be obtained from EPA QA/G-9.

3.3.5.10.4 Project completeness assessment. Completeness assessment for the project is also discussed in EM 200-1-6. Procedures for the contractor as well as for USACE anticipated for the project should be defined within this section of the QAPP.

3.3.6 Appendices. References, standard forms, and a list of abbreviations and acronyms, for example, should be included in appendices.

Chapter 4
Sampling and Analysis Protocols

4.1 General

This chapter provides guidance to USACE personnel and USACE contractors for using the sampling and analytical instructions in the appendices to this manual and for developing project-specific instructions if project-specific characteristics make it impractical to use the sampling and analytical instructions found in these appendices. Issues other than those identified in the general SAP format requirements found in Chapter 3 may have to be included in the SAP to meet project-specific regulatory requirements. To meet project-specific protocols and satisfy any additional requirements, additional field and analytical SOPs and references have been included in Appendix A. General guidance for developing additional site-specific instructions has been included in this chapter. With respect to sampling and analytical protocols, the information provided herein may be used to prepare the SOW for the project or to prepare the SAP. In some instances, data collection activities will occur that are not covered by this manual. The references in Appendix A and the discussion in paragraph 4.4 may be useful under these circumstances.

4.2 Selecting Sampling and Analytical Instructions

As discussed in paragraph 2.3, selection of sampling and analytical protocols for a specific site is dependent upon the site constraints, data needs and data quality objectives, and sampling strategies for the various media. After an analysis of these factors has been completed, sufficient information should exist to select appropriate sampling and analytical instructions from the appendices in this manual. As discussed in EM 200-1-2, sampling and analytical options and appropriate SOPs or instructions should be selected after consideration of the following criteria: schedule, regulatory, technical (effectiveness and implementability), and budget. Guidance to follow during the selection process is provided in the following subsections.

4.2.1 Sampling instructions. Information gathered from Steps 1 and 2 discussed in paragraph 2.3 should be used to identify applicable sampling protocols from the instructions in the appendices. An analysis of the constraints at the site will provide information needed to propose sampling locations and sampling procedures. This analysis should consider the media to be sampled, the types of contaminants, and the physical characteristics of the site. Project resource constraints will also be a factor. An analysis of data needs and DQOs will identify applicability of filtration, compositing, and homogenization procedures and field QC requirements. Sampling strategies should also be reviewed to determine the location and frequency of samples. After this information has been reviewed, appropriate sampling method options may be developed from the instructions in the appendices. If the instructions in the appendices do not contain an appropriate sampling method, alternative methods may be developed using the relevant references in Appendix A and the procedures described in paragraph 4.4.

4.2.2 Analytical instructions. The information needed to properly select an analytical instruction can be obtained from following Steps 1 and 2 of paragraph 2.3. Analysis of the constraints at the site provides information about the sample matrix, measurement parameters, and regulatory and customer preferences in regard to the type of analytical method to be used. A review of the data needs may define additional sample handling procedures, including homogenization and subsampling requirements, detection and quantitation limit requirements, instrumentation requirements, and appropriate analytical methods. After this information has been reviewed, appropriate analytical options may be identified from the instructions in Appendix I. If the instructions identified in Appendix I do not contain an

appropriate analytical method, the relevant references in Appendix A and the procedures in paragraph 4.4 may be used to develop additional instructions.

4.3 Additional Standard Operating Procedures

If the appendices do not contain appropriate sampling and analytical protocols, it will be necessary to develop additional instructions. Paragraphs 2.3 and 4.2 of this manual should be consulted when deciding if other instructions need to be developed. Paragraph 4.4 discusses the methodology for developing instructions. The references in Appendix A contain information that may be used to develop additional instructions.

4.4 Development of Project-Specific Protocols

As previously discussed, it may be necessary to develop sampling and analytical protocols other than those identified in the appendices. Additional instructions may be required for a myriad of reasons: client preferences, regulators' preferences, unusual site conditions, budget considerations, etc. If it is determined that new sampling and analytical protocols need to be developed, or protocols other than those found in the appendices are preferred, then this section and the references in Appendix A can be used to develop the new protocols. However, it is important that the new instructions are able to satisfy data needs and DQOs as well as satisfying scheduling, regulatory, technical, and budget criteria. Guidance for developing new instructions follows. Additional information can be found in several of the references in Appendix A, especially EPA/600/2-80/018, EPA 600/4-79/020, EPA SW-846, and EPA/540/P-87/001.

4.4.1 Sampling instructions. The following list is a template that may be used as an outline to develop new sampling instructions. The references in Appendix A provide additional guidance.

(1) Scope and purpose.

(2) Definitions.

(3) Applicability.

(4) Sample locations.

(5) Applicable sampling strategies (discrete/composite: random, judgmental, stratified, etc.).

(6) When filtration is applicable (sampling for dissolved metals).

(7) When homogenization is applicable (sampling solid media).

(8) Method specified in entirety (step-by-step presentation).

(9) Field QC requirements (all field duplicates, all QA splits, trip blanks, background samples, highly contaminated media rinsates).

(10) Split-sample techniques/deviations from normal protocol.

(11) Preservation techniques (cool, acid preservation, base preservation, chlorine binding).

(12) Field measurements.

(13) Miscellaneous considerations.

4.4.2 Analytical instructions. The following list is a template that may be used as an outline to develop new analytical instructions. The references in Appendix A provide additional guidance.

(1) Title/Signature/Effective Date page

(2) Scope and application, including applicability to various matrices and discrete/composite procedures.

(3) Method summary

(4) Sample preservation

(5) Containers, handling, and storage

(6) Interferences and potential problems

(7) Equipment and apparatus

(8) Reagents and solutions

(9) Procedures

- Applicable sample preparation and cleanup procedures.
- Any applicable special sample handling requirements.
- Analytical method specified in entirety (step-by-step presentation).
- Instrumentation requirements.

(10) Calculations

(11) QC requirements for second-column confirmation, and/or the analysis of surrogates, matrix spikes, internal standards, blanks, laboratory control samples. All QC elements should define appropriate measurement quality objectives (MQOs) for appropriate data quality indicators (i.e., precision and bias).

(12) Corrective actions

(13) Data evaluation

(14) Method detection limit studies/sensitivity assessment

(15) Analyst experience requirements

(16) Health and safety

(17) Sample disposal

(18) References

(19) Definitions

(20) Example forms